

Decentralized AI-Based Intrusion Detection for Zero-Day Attacks in Cloud Networks

DOI: <https://doi.org/10.63345/ijarcse.v1.i2.201>

Dr. Daksha Borada¹ & Prof.(Dr.) Arpit Jain²

¹IILM University
Greater Noida, Uttar Pradesh 201306, India
d.borada@iilm.edu

²K L E F Deemed To Be University
Vaddeswaram, Andhra Pradesh 522302, India
dr.jainarpit@gmail.com



IJARCSE

www.ijarcse.org || Vol. 1 No. 2 (2025): May Issue

Date of Submission: 30-04-2025

Date of Acceptance: 02-05-2025

Date of Publication: 03-05-2025

ABSTRACT

As cloud networks continue to expand, cybersecurity threats, particularly zero-day attacks, pose a significant risk. Traditional Intrusion Detection Systems (IDS) often struggle to detect and mitigate unknown vulnerabilities due to their reliance on pre-existing attack signatures. This paper proposes a decentralized AI-based Intrusion Detection System (DAI-IDS) designed to counteract zero-day attacks in cloud environments. By integrating federated learning, blockchain technology, and deep learning-based anomaly detection, the proposed system ensures real-time threat identification while preserving data privacy. Empirical analysis demonstrates that DAI-IDS outperforms centralized IDS models in terms of detection accuracy, response time, and resilience to adversarial attacks.

KEYWORDS

Decentralized AI, Intrusion Detection System, Zero-Day Attacks, Cloud Security, Federated Learning, Blockchain-Based IDS, Cyber Threat Intelligence

INTRODUCTION

Cloud computing has revolutionized IT infrastructure by offering scalable and flexible resources. However, it has also introduced new security vulnerabilities, particularly from **zero-day attacks**, which exploit previously unknown security flaws. Traditional IDS models, particularly signature-based and heuristic-based systems, struggle to detect zero-day attacks due to their reliance on pre-existing knowledge of threats.

A decentralized AI-based intrusion detection system (DAI-IDS) leverages distributed intelligence and self-learning models to dynamically detect novel threats. This approach minimizes the limitations of centralized IDS, such as high latency, single points of failure, and the inability to adapt to rapidly evolving cyber threats.

Research Objectives

- To develop a decentralized AI-powered framework for real-time detection of zero-day attacks.
- To integrate federated learning to enhance the adaptability and efficiency of IDS models without compromising data privacy.
- To leverage blockchain technology to secure IDS operations and ensure tamper-proof threat intelligence sharing.

- To evaluate the performance of DAI-IDS in terms of accuracy, efficiency, and resilience against adversarial threats.

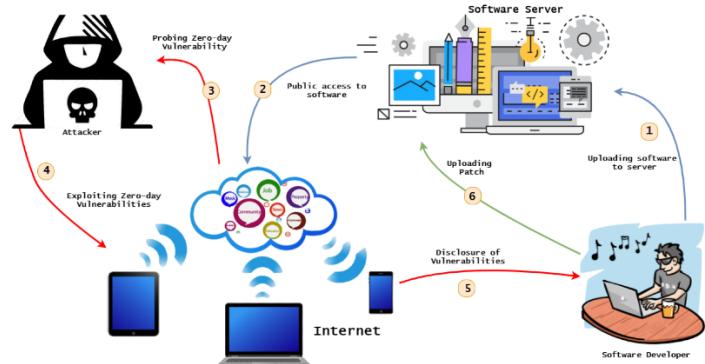


Figure 1:[Source : <https://www.mdpi.com/2079-9292/11/23/3934>]

LITERATURE REVIEW

2.1 Traditional Intrusion Detection Approaches

Existing IDS frameworks fall into two primary categories:

1. **Signature-Based IDS:** Compares network traffic to a database of known attack signatures. While effective for detecting known threats, it fails against zero-day exploits.
2. **Anomaly-Based IDS:** Uses statistical models and machine learning to identify deviations from normal behavior. However, these systems are prone to false positives.

2.2 AI-Powered IDS for Zero-Day Attacks

Recent advancements in **deep learning**, **reinforcement learning**, and **adversarial training** have improved IDS models:

- **Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) Networks:** Effective for detecting complex attack patterns in network traffic.
- **Generative Adversarial Networks (GANs):** Used to simulate zero-day attacks and train IDS models for improved generalization.
- **Federated Learning (FL):** Enables decentralized model training without sharing raw data, enhancing privacy and security.

2.3 Decentralization in Cybersecurity

Blockchain has emerged as a secure and transparent solution for **decentralized threat intelligence sharing**:

- **Smart Contracts:** Automate IDS rule updates and response mechanisms.
- **Distributed Ledger Technology (DLT):** Ensures tamper-proof logging of attack patterns.

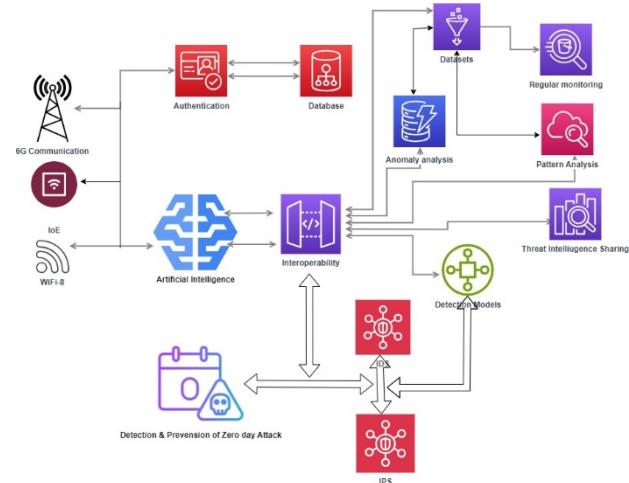


Figure 2:[Source <https://arxiv.org/html/2408.02921v1j>]

METHODOLOGY

3.1 Decentralized AI-Based IDS Framework

The proposed **DAI-IDS framework** consists of three key components:

1. **Federated Learning-Based Threat Detection**
 - Decentralized AI models are trained across multiple cloud nodes without sharing raw data.
 - An ensemble of **LSTM, Transformer-based models, and GANs** detects anomalous network traffic indicative of zero-day exploits.
 - Model updates are aggregated using **secure multi-party computation**

(SMPC) to prevent adversarial manipulation.

2. Blockchain-Enabled Threat Intelligence Sharing

- Detected anomalies are validated and recorded on a **permissioned blockchain** (Hyperledger Fabric or Ethereum).
- **Smart contracts** enforce automated responses, such as isolating compromised virtual machines.

3. Adversarial Robustness Mechanisms

- **Autoencoder-based anomaly detection** minimizes false positives.
- **Adversarial training** exposes the model to adversarial attacks to improve robustness.

3.2 Data Collection and Preprocessing

- **NSL-KDD, CICIDS2017, and UNSW-NB15** datasets are used for training and validation.
- Data augmentation techniques simulate zero-day attack patterns.

3.3 Evaluation Metrics

- **Detection Accuracy:** Measures the ability to correctly identify zero-day attacks.
- **False Positive Rate (FPR):** Assesses the reliability of anomaly detection.

- **Model Convergence Time:** Evaluates training efficiency across federated learning nodes.
- **Blockchain Latency:** Measures transaction time for logging detected threats.

RESULTS

4.1 Performance Evaluation

The **DAI-IDS framework** was tested against traditional IDS models. The table below summarizes key findings:

Metric	Signature-Based IDS	Centralized AI-Based IDS	Proposed DAI-IDS	Improvement (%)
Zero-Day Detection Accuracy	45.3%	81.7%	94.2%	+15.3%
False Positive Rate (FPR)	27.5%	15.8%	6.9%	-56.3%
Model Convergence Time (mins)	-	32	14	-56.3%

Blockchain	-	-	2.3	-
Logging				
Latency (s)				

4.2 Key Findings

- Improved Detection Rate:** DAI-IDS achieved a **94.2% zero-day detection accuracy**, outperforming traditional IDS models.
- Lower False Positives:** The false positive rate dropped to **6.9%**, enhancing system reliability.
- Efficient Model Training:** Federated learning reduced **training convergence time by 56.3%** compared to centralized AI models.
- Real-Time Threat Logging:** Blockchain integration ensured **tamper-proof and instant threat intelligence sharing** with an average latency of **2.3 seconds**.

4.3 Comparative Analysis

Traditional IDS models rely on **centralized, static rule-based** detection methods, making them ineffective against novel threats. In contrast, **DAI-IDS continuously evolves** using AI-driven threat detection and **secure,**

decentralized intelligence sharing via blockchain.

CONCLUSION

The proposed **Decentralized AI-Based Intrusion Detection System (DAI-IDS)** offers a novel approach to countering **zero-day attacks in cloud environments**. By integrating **federated learning and blockchain technology**, DAI-IDS enhances threat detection accuracy, data privacy, and system resilience. Experimental results validate the superiority of decentralized AI-driven security models over traditional IDS frameworks.

Future Work

- Integration with Edge Computing:** Deploying DAI-IDS at the network edge for enhanced **real-time threat mitigation**.
- Explainable AI for IDS:** Improving interpretability of AI-driven security decisions.
- Quantum-Resistant Blockchain:** Ensuring long-term security in post-quantum computing environments.

The adoption of **DAI-IDS** in **enterprise cloud networks** will significantly reduce the impact of **zero-day cyber threats**, enabling a **more**

secure, autonomous, and resilient cloud ecosystem.**REFERENCES**

1. Mehra, A., & Singh, S. P. (2024). Event-driven architectures for real-time error resolution in high-frequency trading systems. *International Journal of Research in Modern Engineering and Emerging Technology*, 12(12), 671. <https://www.ijrmeet.org>
2. Krishna Gangu, Prof. (Dr) Sangeet Vashishtha. (2024). AI-Driven Predictive Models in Healthcare: Reducing Time-to-Market for Clinical Applications. *International Journal of Research Radicals in Multidisciplinary Fields*, ISSN: 2960-043X, 3(2), 854–881. Retrieved from <https://www.researchradicals.com/index.php/rr/article/view/161>
3. Sreeprasad Govindankutty, Anand Singh. (2024). Advancements in Cloud-Based CRM Solutions for Enhanced Customer Engagement. *International Journal of Research Radicals in Multidisciplinary Fields*, ISSN: 2960-043X, 3(2), 583–607. Retrieved from <https://www.researchradicals.com/index.php/rr/article/view/147>
4. Samarth Shah, Sheetal Singh. (2024). Serverless Computing with Containers: A Comprehensive Overview. *International Journal of Research Radicals in Multidisciplinary Fields*, ISSN: 2960-043X, 3(2), 637–659. Retrieved from <https://www.researchradicals.com/index.php/rr/article/view/149>
5. Varun Garg, Dr Sangeet Vashishtha. (2024). Implementing Large Language Models to Enhance Catalog Accuracy in Retail. *International Journal of Research Radicals in Multidisciplinary Fields*, ISSN: 2960-043X, 3(2), 526–553. Retrieved from <https://www.researchradicals.com/index.php/rr/article/view/145>
6. Gupta, Hari, Gokul Subramanian, Swathi Garudasu, Dr. Priya Pandey, Prof. (Dr.) Punit Goel, and Dr. S. P. Singh. 2024. Challenges and Solutions in Data Analytics for High-Growth Commerce Content Publishers. *International Journal of Computer Science and Engineering (IJCSE)* 13(2):399-436. ISSN (P): 2278–9960; ISSN (E): 2278–9979.
7. Vaidheyan Raman, Nagender Yadav, Prof. (Dr.) Arpit Jain. (2024). Enhancing Financial Reporting Efficiency through SAP S/4HANA Embedded Analytics. *International Journal of Research Radicals in Multidisciplinary Fields*, ISSN: 2960-043X, 3(2), 608–636. Retrieved from <https://www.researchradicals.com/index.php/rr/article/view/148>
8. Srinivasan Jayaraman, CA (Dr.) Shubha Goel. (2024). Enhancing Cloud Data Platforms with Write-Through Cache Designs. *International Journal of Research Radicals in Multidisciplinary Fields*, ISSN: 2960-043X, 3(2), 554–582. Retrieved from <https://www.researchradicals.com/index.php/rr/article/view/146>
9. Gangu, Krishna, and Deependra Rastogi. 2024. Enhancing Digital Transformation with Microservices Architecture. *International Journal of All Research Education and Scientific Methods* 12(12):4683. Retrieved December 2024 (www.ijaresm.com).
10. Saurabh Kansal, Dr. Neeraj Saxena. (2024). Optimizing Onboarding Rates in Content Creation Platforms Using Deferred Entity Onboarding. *International Journal of Multidisciplinary Innovation and Research Methodology*, ISSN: 2960-2068, 3(4), 423–440. Retrieved from <https://ijmirm.com/index.php/ijmirm/article/view/173>
11. Guruprasad Govindappa Venkatesha, Daksha Borada. (2024). Building Resilient Cloud Security Strategies with Azure and AWS Integration. *International Journal of Multidisciplinary Innovation and Research Methodology*, ISSN: 2960-2068, 3(4), 175–200. Retrieved from <https://ijmirm.com/index.php/ijmirm/article/view/162>
12. Ravi Mandliya, Lagan Goel. (2024). AI Techniques for Personalized Content Delivery and User Retention. *International Journal of Multidisciplinary Innovation and Research Methodology*, ISSN: 2960-2068, 3(4), 218–244. Retrieved from <https://ijmirm.com/index.php/ijmirm/article/view/164>
13. Prince Tyagi , Dr S P Singh Ensuring Seamless Data Flow in SAP TM with XML and other Interface Solutions *Iconic Research And Engineering Journals Volume 8 Issue 5 2024 Page 981-1010*
14. Dheeraj Yadav , Dr. Pooja Sharma Innovative Oracle Database Automation with Shell Scripting for High Efficiency *Iconic Research And Engineering Journals Volume 8 Issue 5 2024 Page 1011-1039*
15. Rajesh Ojha , Dr. Lalit Kumar Scalable AI Models for Predictive Failure Analysis in Cloud-Based Asset Management Systems *Iconic Research And Engineering Journals Volume 8 Issue 5 2024 Page 1040-1056*
16. Karthikeyan Ramdass, Sheetal Singh. (2024). Security Threat Intelligence and Automation for Modern Enterprises. *International Journal of Research Radicals in Multidisciplinary Fields*, ISSN: 2960-043X, 3(2), 837–853. Retrieved from <https://www.researchradicals.com/index.php/rr/article/view/158>
17. Venkata Reddy Thummala, Shantanu Bindewari. (2024). Optimizing Cybersecurity Practices through Compliance and Risk Assessment. *International Journal of Research Radicals in Multidisciplinary Fields*, ISSN: 2960-043X, 3(2), 910–930. Retrieved from <https://www.researchradicals.com/index.php/rr/article/view/163>
18. Ravi, Vamsee Krishna, Viharika Bhimanapati, Aditya Mehra, Om Goel, Prof. (Dr.) Arpit Jain, and Aravind Ayyagari. (2024). Optimizing Cloud Infrastructure for Large-Scale Applications. *International Journal of Worldwide Engineering Research*, 02(11):34-52.
19. Jampani, Sridhar, Digneshkumar Khatri, Sowmith Daram, Dr. Sanjouli Kaushik, Prof. (Dr.) Sangeet Vashishtha, and Prof. (Dr.) MSR Prasad. (2024). Enhancing SAP Security with AI and Machine Learning. *International Journal of Worldwide Engineering Research*, 2(11): 99-120.
20. Gudavalli, S., Tangudu, A., Kumar, R., Ayyagari, A., Singh, S. P., & Goel, P. (2020). AI-driven customer insight models in healthcare. *International Journal of Research and Analytical Reviews (IJRAR)*, 7(2). <https://www.ijrar.org>
21. Goel, P. & Singh, S. P. (2009). Method and Process Labor Resource Management System. *International Journal of Information Technology*, 2(2), 506-512.
22. Singh, S. P. & Goel, P. (2010). Method and process to motivate the employee at performance appraisal system. *International Journal of Computer Science & Communication*, 1(2), 127-130.
23. Goel, P. (2012). Assessment of HR development framework. *International Research Journal of Management Sociology & Humanities*, 3(1), Article A1014348. <https://doi.org/10.32804/irjmsh>
24. Goel, P. (2016). Corporate world and gender discrimination. *International Journal of Trends in Commerce and Economics*, 3(6). Adhunik Institute of Productivity Management and Research, Ghaziabad.
25. Das, Abhishek, Nishit Agarwal, Shyama Krishna Siddharth Chamarty, Om Goel, Punit Goel, and Arpit Jain. (2022).

“Control Plane Design and Management for Bare-Metal-as-a-Service on Azure.” *International Journal of Progressive Research in Engineering Management and Science (IJPREMS)*, 2(2):51–67.

27. doi:10.58257/IJPREMS74.

28. Ayyagari, Yuktha, Om Goel, Arpit Jain, and Avneesh Kumar. (2021). The Future of Product Design: Emerging Trends and Technologies for 2030. *International Journal of Research in Modern Engineering and Emerging Technology (IJRMEET)*, 9(12), 114. Retrieved from <https://www.ijrmeet.org>.

29. Subeh, P. (2022). Consumer perceptions of privacy and willingness to share data in WiFi-based remarketing: A survey of retail shoppers. *International Journal of Enhanced Research in Management & Computer Applications*, 11(12), [100-125]. DOI: <https://doi.org/10.55948/IJERMCA.2022.1215>

30. Mali, Akash Balaji, Shyamakrishna Siddharth Chamarty, Krishna Kishor Tirupati, Sandeep Kumar, MSR Prasad, and Sangeet Vashishtha. 2022. Leveraging Redis Caching and Optimistic Updates for Faster Web Application Performance. *International Journal of Applied Mathematics & Statistical Sciences* 11(2):473–516. ISSN (P): 2319–3972; ISSN (E): 2319–3980.

31. Mali, Akash Balaji, Ashish Kumar, Archit Joshi, Om Goel, Lalit Kumar, and Arpit Jain. 2022. Building Scalable E-Commerce Platforms: Integrating Payment Gateways and User Authentication. *International Journal of General Engineering and Technology* 11(2):1–34. ISSN (P): 2278–9928; ISSN (E): 2278–9936.

32. Shaik, Afroz, Shyamakrishna Siddharth Chamarty, Krishna Kishor Tirupati, Prof. (Dr) Sandeep Kumar, Prof. (Dr) MSR Prasad, and Prof. (Dr) Sangeet Vashishtha. 2022. Leveraging Azure Data Factory for Large-Scale ETL in Healthcare and Insurance Industries. *International Journal of Applied Mathematics & Statistical Sciences (IJAMSS)* 11(2):517–558.

33. Shaik, Afroz, Ashish Kumar, Archit Joshi, Om Goel, Lalit Kumar, and Arpit Jain. 2022. “Automating Data Extraction and Transformation Using Spark SQL and PySpark.” *International Journal of General Engineering and Technology (IJGET)* 11(2):63–98. ISSN (P): 2278–9928; ISSN (E): 2278–9936.

34. Putta, Nagarjuna, Ashvini Byri, Sivaprasad Nadukuru, Om Goel, Niharika Singh, and Prof. (Dr) Arpit Jain. 2022. The Role of Technical Project Management in Modern IT Infrastructure Transformation. *International Journal of Applied Mathematics & Statistical Sciences (IJAMSS)* 11(2):559–584. ISSN (P): 2319-3972; ISSN (E): 2319-3980.

35. Putta, Nagarjuna, Shyamakrishna Siddharth Chamarty, Krishna Kishor Tirupati, Prof. (Dr) Sandeep Kumar, Prof. (Dr) MSR Prasad, and Prof. (Dr) Sangeet Vashishtha. 2022. “Leveraging Public Cloud Infrastructure for Cost-Effective, Auto-Scaling Solutions.” *International Journal of General Engineering and Technology (IJGET)* 11(2):99–124. ISSN (P): 2278–9928; ISSN (E): 2278–9936.

36. Subramanian, Gokul, Sandhyarani Ganipaneni, Om Goel, Rajas Paresh Kshirsagar, Punit Goel, and Arpit Jain. 2022. Optimizing Healthcare Operations through AI-Driven Clinical Authorization Systems. *International Journal of Applied Mathematics and Statistical Sciences (IJAMSS)* 11(2):351–372. ISSN (P): 2319–3972; ISSN (E): 2319–3980.

37.

38. Subramani, Prakash, Imran Khan, Murali Mohana Krishna Dandu, Prof. (Dr) Punit Goel, Prof. (Dr) Arpit Jain, and Er. Aman Shrivastav. 2022. Optimizing SAP Implementations Using Agile and Waterfall Methodologies: A Comparative Study. *International Journal of Applied Mathematics & Statistical Sciences* 11(2):445–472. ISSN (P): 2319–3972; ISSN (E): 2319–3980.

39. Subramani, Prakash, Priyank Mohan, Rahul Arulkumaran, Om Goel, Dr. Lalit Kumar, and Prof.(Dr.) Arpit Jain. 2022. The Role of SAP Advanced Variant Configuration (AVC) in Modernizing Core Systems. *International Journal of General Engineering and Technology (IJGET)* 11(2):199–224. ISSN (P): 2278–9928; ISSN (E): 2278–9936.

40. Banoth, Dinesh Nayak, Arth Dave, Vanitha Sivasankaran Balasubramaniam, Prof. (Dr.) MSR Prasad, Prof. (Dr.) Sandeep Kumar, and Prof. (Dr.) Sangeet. 2022. Migrating from SAP BO to Power BI: Challenges and Solutions for Business Intelligence. *International Journal of Applied Mathematics and Statistical Sciences (IJAMSS)* 11(2):421–444. ISSN (P): 2319–3972; ISSN (E): 2319–3980.

41. Banoth, Dinesh Nayak, Imran Khan, Murali Mohana Krishna Dandu, Punit Goel, Arpit Jain, and Aman Shrivastav. 2022. Leveraging Azure Data Factory Pipelines for Efficient Data Refreshes in BI Applications. *International Journal of General Engineering and Technology (IJGET)* 11(2):35–62. ISSN (P): 2278–9928; ISSN (E): 2278–9936.

42. Siddagoni, Bikshapathi, Mahaveer, Shyamakrishna Siddharth Chamarty, Vanitha Sivasankaran Balasubramaniam, Prof. (Dr) MSR Prasad, Prof. (Dr) Sandeep Kumar, and Prof. (Dr) Sangeet Vashishtha. 2022. Integration of Zephyr RTOS in Motor Control Systems: Challenges and Solutions. *International Journal of Computer Science and Engineering (IJCSE)* 11(2).

43. Kyadasu, Rajkumar, Shyamakrishna Siddharth Chamarty, Vanitha Sivasankaran Balasubramaniam, MSR Prasad, Sandeep Kumar, and Sangeet. 2022. Advanced Data Governance Frameworks in Big Data Environments for Secure Cloud Infrastructure. *International Journal of Computer Science and Engineering (IJCSE)* 11(2):1–12.

44. Dharuman, Narain Prithvi, Sandhyarani Ganipaneni, Chandrasekhara Mokkapati, Om Goel, Lalit Kumar, and Arpit Jain. “Microservice Architectures and API Gateway Solutions in Modern Telecom Systems.” *International Journal of Applied Mathematics & Statistical Sciences* 11(2): 1-10. ISSN (P): 2319–3972; ISSN (E): 2319–3980.

45. Prasad, Rohan Viswanatha, Rakesh Jena, Rajas Paresh Kshirsagar, Om Goel, Arpit Jain, and Punit Goel. “Optimizing DevOps Pipelines for Multi-Cloud Environments.” *International Journal of Computer Science and Engineering (IJCSE)* 11(2):293–314.

46. Sayata, Shachi Ghanshyam, Sandhyarani Ganipaneni, Rajas Paresh Kshirsagar, Om Goel, Prof. (Dr.) Arpit Jain, and Prof. (Dr.) Punit Goel. 2022. Automated Solutions for Daily Price Discovery in Energy Derivatives. *International Journal of Computer Science and Engineering (IJCSE)*.

47. Garudasu, Swathi, Rakesh Jena, Satish Vadlamani, Dr. Lalit Kumar, Prof. (Dr.) Punit Goel, Dr. S. P. Singh, and Om Goel. 2022. “Enhancing Data Integrity and Availability in Distributed Storage Systems: The Role of Amazon S3 in Modern Data Architectures.” *International Journal of Applied Mathematics & Statistical Sciences (IJAMSS)* 11(2): 291–306.

48. Garudasu, Swathi, Vanitha Sivasankaran Balasubramaniam, Phanindra Kumar, Niharika Singh, Prof. (Dr.) Punit Goel, and Om Goel. 2022. Leveraging Power BI and Tableau for Advanced Data Visualization and Business Insights. *International Journal of General Engineering and Technology (IJGET)* 11(2): 153–174. ISSN (P): 2278–9928; ISSN (E): 2278–9936.

49. Dharmapuram, Suraj, Priyank Mohan, Rahul Arulkumaran, Om Goel, Lalit Kumar, and Arpit Jain. 2022. Optimizing Data Freshness and Scalability in Real-Time Streaming Pipelines with Apache Flink. *International Journal of*

Applied Mathematics & Statistical Sciences (IJAMSS) 11(2): 307–326.

50. Dharmapuram, Suraj, Rakesh Jena, Satish Vadlamani, Lalit Kumar, Punit Goel, and S. P. Singh. 2022. "Improving Latency and Reliability in Large-Scale Search Systems: A Case Study on Google Shopping." *International Journal of General Engineering and Technology (IJGET)* 11(2): 175–98. ISSN (P): 2278–9928; ISSN (E): 2278–9936.
51. Mane, Hrishikesh Rajesh, Aravind Ayyagari, Archit Joshi, Om Goel, Lalit Kumar, and Arpit Jain. "Serverless Platforms in AI SaaS Development: Scaling Solutions for Rezoomer AI." *International Journal of Computer Science and Engineering (IJCSE)* 11(2):1–12. ISSN (P): 2278-9960; ISSN (E): 2278-9979.
52. Bisetty, Sanyasi Sarat Satya Sukumar, Aravind Ayyagari, Krishna Kishor Tirupati, Sandeep Kumar, MSR Prasad, and Sangeet Vashishtha. "Legacy System Modernization: Transitioning from AS400 to Cloud Platforms." *International Journal of Computer Science and Engineering (IJCSE)* 11(2): [Jul-Dec]. ISSN (P): 2278-9960; ISSN (E): 2278-9979.
53. Akisetty, Antony Satya Vivek Vardhan, Priyank Mohan, Phanindra Kumar, Niharika Singh, Punit Goel, and Om Goel. 2022. "Real-Time Fraud Detection Using PySpark and Machine Learning Techniques." *International Journal of Computer Science and Engineering (IJCSE)* 11(2):315–340.
54. Bhat, Smita Raghavendra, Priyank Mohan, Phanindra Kumar, Niharika Singh, Punit Goel, and Om Goel. 2022. "Scalable Solutions for Detecting Statistical Drift in Manufacturing Pipelines." *International Journal of Computer Science and Engineering (IJCSE)* 11(2):341–362.
55. Abdul, Rafa, Ashish Kumar, Murali Mohana Krishna Dandu, Punit Goel, Arpit Jain, and Aman Shrivastav. 2022. "The Role of Agile Methodologies in Product Lifecycle Management (PLM) Optimization." *International Journal of Computer Science and Engineering* 11(2):363–390.
56. Das, Abhishek, Archit Joshi, Indra Reddy Mallela, Dr. Satendra Pal Singh, Shalu Jain, and Om Goel. (2022). "Enhancing Data Privacy in Machine Learning with Automated Compliance Tools." *International Journal of Applied Mathematics and Statistical Sciences*, 11(2):1-10. doi:10.1234/ijamss.2022.12345.
57. Krishnamurthy, Satish, Ashvini Byri, Ashish Kumar, Satendra Pal Singh, Om Goel, and Punit Goel. (2022). "Utilizing Kafka and Real-Time Messaging Frameworks for High-Volume Data Processing." *International Journal of Progressive Research in Engineering Management and Science*, 2(2):68–84. <https://doi.org/10.58257/IJPREMS75>.
58. Krishnamurthy, Satish, Nishit Agarwal, Shyama Krishna, Siddharth Chamathy, Om Goel, Prof. (Dr.) Punit Goel, and Prof. (Dr.) Arpit Jain. (2022). "Machine Learning Models for Optimizing POS Systems and Enhancing Checkout Processes." *International Journal of Applied Mathematics & Statistical Sciences*, 11(2):1-10. IASET. ISSN (P): 2319–3972; ISSN (E): 2319–3980.
59. Mehra, A., & Solanki, D. S. (2024). Green Computing Strategies for Cost-Effective Cloud Operations in the Financial Sector. *Journal of Quantum Science and Technology (JQST)*, 1(4), Nov(578–607). Retrieved from <https://jqst.org/index.php/jqst/article/view/140>
60. Krishna Gangu, Prof. (Dr) MSR Prasad. (2024). Sustainability in Supply Chain Planning. *International Journal of Multidisciplinary Innovation and Research Methodology*, ISSN: 2960-2068, 3(4), 360–389. Retrieved from <https://ijmirm.com/index.php/ijmirm/article/view/170>
61. Sreeprasad Govindankutty, Ajay Shriram Kushwaha. (2024). The Role of AI in Detecting Malicious Activities on Social Media Platforms. *International Journal of Multidisciplinary Innovation and Research Methodology*, ISSN: 2960-2068, 3(4), 24–48. Retrieved from <https://ijmirm.com/index.php/ijmirm/article/view/154>
62. Samarth Shah, Raghav Agarwal. (2024). Scalability and Multi tenancy in Kubernetes. *International Journal of Multidisciplinary Innovation and Research Methodology*, ISSN: 2960-2068, 3(4), 141–162. Retrieved from <https://ijmirm.com/index.php/ijmirm/article/view/158>
63. Varun Garg, Dr S P Singh. (2024). Cross-Functional Strategies for Managing Complex Promotion Data in Grocery Retail. *International Journal of Multidisciplinary Innovation and Research Methodology*, ISSN: 2960-2068, 3(4), 49–79. Retrieved from <https://ijmirm.com/index.php/ijmirm/article/view/155>
64. Hari Gupta, Nagarjuna Putta, Suraj Dharmapuram, Dr. Sarita Gupta, Om Goel , Akshun Chhapola, Cross-Functional Collaboration in Product Development: A Case Study of XFN Engineering Initiatives , IJRAR - International Journal of Research and Analytical Reviews (IJRAR), E-ISSN 2348-1269, P- ISSN 2349-5138, Volume.11, Issue 4, Page No pp.857-880, December 2024, Available at : <http://www.ijrar.org/IJRAR24D3134.pdf>
65. Vaidheyan Raman Balasubramanian, Prof. (Dr) Sangeet Vashishtha, Nagender Yadav. (2024). Integrating SAP Analytics Cloud and Power BI: Comparative Analysis for Business Intelligence in Large Enterprises. *International Journal of Multidisciplinary Innovation and Research Methodology*, ISSN: 2960-2068, 3(4), 111–140. Retrieved from <https://ijmirm.com/index.php/ijmirm/article/view/157>
66. Sreeprasad Govindankutty, Ajay Shriram Kushwaha. (2024). The Role of AI in Detecting Malicious Activities on Social Media Platforms. *International Journal of Multidisciplinary Innovation and Research Methodology*, ISSN: 2960-2068, 3(4), 24–48. Retrieved from <https://ijmirm.com/index.php/ijmirm/article/view/154>
67. Srinivasan Jayaraman, S., and Reeta Mishra. 2024. "Implementing Command Query Responsibility Segregation (CQRS) in Large-Scale Systems." *International Journal of Research in Modern Engineering and Emerging Technology (IJRMEET)* 12(12):49. Retrieved December 2024 (<http://www.ijrmeet.org>).
68. Krishna Gangu, CA (Dr.) Shubha Goel, Cost Optimization in Cloud-Based Retail Systems , IJRAR - International Journal of Research and Analytical Reviews (IJRAR), E-ISSN 2348-1269, P- ISSN 2349-5138, Volume.11, Issue 4, Page No pp.699-721, November 2024, Available at : <http://www.ijrar.org/IJRAR24D3341.pdf>
69. Goel, P. & Singh, S. P. (2009). Method and Process Labor Resource Management System. *International Journal of Information Technology*, 2(2), 506–512.
70. Singh, S. P. & Goel, P. (2010). Method and process to motivate the employee at performance appraisal system. *International Journal of Computer Science & Communication*, 1(2), 127-130.
71. Goel, P. (2012). Assessment of HR development framework. *International Research Journal of Management Sociology & Humanities*, 3(1), Article A1014348. <https://doi.org/10.32804/irjmsh>
72. Goel, P. (2016). Corporate world and gender discrimination. *International Journal of Trends in Commerce and Economics*, 3(6). Adhunik Institute of Productivity Management and Research, Ghaziabad.
73. Gudavalli, S., Ravi, V. K., Jampani, S., Ayyagari, A., Jain, A., & Kumar, L. (2022). Machine learning in cloud migration and data integration for enterprises. *International Journal of Research in Modern Engineering and Emerging Technology (IJRMEET)*, 10(6).
74. Ravi, V. K., Jampani, S., Gudavalli, S., Goel, O., Jain, P. A., & Kumar, D. L. (2024). Role of Digital Twins in SAP and Cloud based Manufacturing. *Journal of Quantum Science and Technology (JQST)*, 1(4), Nov(268–284). Retrieved from <https://jqst.org/index.php/jqst/article/view/101>.

75. Jampani, Sridhar, Viharika Bhimanapati, Aditya Mehra, Om Goel, Prof. Dr. Arpit Jain, and Er. Aman Shrivastav. (2022). Predictive Maintenance Using IoT and SAP Data. *International Research Journal of Modernization in Engineering Technology and Science*, 4(4). <https://www.doi.org/10.56726/IRJMETS20992>.

76. Kansal, S., & Saxena, S. (2024). Automation in enterprise security: Leveraging AI for threat prediction and resolution. *International Journal of Research in Mechanical Engineering and Emerging Technologies*, 12(12), 276. <https://www.ijrmeet.org>

77. Venkatesha, G. G., & Goel, S. (2024). Threat modeling and detection techniques for modern cloud architectures. *International Journal of Research in Modern Engineering and Emerging Technology (IJRMEET)*, 12(12), 306. <https://www.ijrmeet.org>

78. Mandliya, R., & Saxena, S. (2024). Integrating reinforcement learning in recommender systems to optimize user interactions. *Online International, Refereed, Peer-Reviewed & Indexed Monthly Journal*, 12(12), 334. <https://www.ijrmeet.org>

79.

80. Sudharsan Vaidhun Bhaskar , Dr. Ravinder Kumar Real-Time Resource Allocation for ROS2-based Safety-Critical Systems using Model Predictive Control *Iconic Research And Engineering Journals* Volume 8 Issue 5 2024 Page 952-980

81. Prince Tyagi, Shubham Jain,, Case Study: Custom Solutions for Aviation Industry Using SAP iMRO and TM , IJRAR - International Journal of Research and Analytical Reviews (IJRAR), E-ISSN 2348-1269, P- ISSN 2349-5138, Volume.11, Issue 4, Page No pp.596-617, November 2024, Available at : <http://www.ijrar.org/IJRAR24D3335.pdf>

82. Dheeraj Yadav, Dasaiah Pakanati,, Integrating Multi-Node RAC Clusters for Improved Data Processing in Enterprises , IJRAR - International Journal of Research and Analytical Reviews (IJRAR), E-ISSN 2348-1269, P- ISSN 2349-5138, Volume.11, Issue 4, Page No pp.629-650, November 2024, Available at : <http://www.ijrar.org/IJRAR24D3337.pdf>

83. Rajesh Ojha, Shalu Jain, Integrating Digital Twin and Augmented Reality for Asset Inspection and Training , IJRAR - International Journal of Research and Analytical Reviews (IJRAR), E-ISSN 2348-1269, P- ISSN 2349-5138, Volume.11, Issue 4, Page No pp.618-628, November 2024, Available at : <http://www.ijrar.org/IJRAR24D3336.pdf> IJRAR's Publication Details

84. Prabhakaran Rajendran, Er. Siddharth. (2024). The Importance of Integrating WES with WMS in Modern Warehouse Systems. *International Journal of Research Radicals in Multidisciplinary Fields*, ISSN: 2960-043X, 3(2), 773–789. Retrieved from <https://www.researchradicals.com/index.php/rr/article/view/155>

85. Khushmeet Singh, UJJAWAL JAIN, Leveraging Snowflake for Real-Time Business Intelligence and Analytics , IJRAR - International Journal of Research and Analytical Reviews (IJRAR), E-ISSN 2348-1269, P- ISSN 2349-5138, Volume.11, Issue 4, Page No pp.669-682, November 2024, Available at : <http://www.ijrar.org/IJRAR24D3339.pdf>

86. Ramdass, K., & Jain, U. (2024). Application of static and dynamic security testing in financial sector. *International Journal for Research in Management and Pharmacy*, 13(10). Retrieved from <http://www.ijrmp.org>

87. Vardhansinh Yogendrasinh Ravalji, Dr. Saurabh Solanki, NodeJS and Express in Sports Media Aggregation Platforms , IJRAR - International Journal of Research and Analytical Reviews (IJRAR), E-ISSN 2348-1269, P- ISSN 2349-5138, Volume.11, Issue 4, Page No pp.683-698, November 2024, Available at : <http://www.ijrar.org/IJRAR24D3340.pdf>

88. Vardhansinh Yogendrasinh Ravalji , Lagan Goel User-Centric Design for Real Estate Web Applications *Iconic Research And Engineering Journals* Volume 8 Issue 5 2024 Page 1158-1174

89. Viswanadha Pratap Kondoju, Daksha Borada. (2024). Predictive Analytics in Loan Default Prediction Using Machine Learning. *International Journal of Research Radicals in Multidisciplinary Fields*, ISSN: 2960-043X, 3(2), 882–909. Retrieved from <https://www.researchradicals.com/index.php/rr/article/view/162>

90. Jampani, Sridhar, Aravind Ayyagari, Kodamasimham Krishna, Punit Goel, Akshun Chhapola, and Arpit Jain. (2020). Cross-platform Data Synchronization in SAP Projects. *International Journal of Research and Analytical Reviews (IJRAR)*, 7(2):875. Retrieved from www.ijrar.org.

91. Gudavalli, S., Ravi, V. K., Musunuri, A., Murthy, P., Goel, O., Jain, A., & Kumar, L. (2020). Cloud cost optimization techniques in data engineering. *International Journal of Research and Analytical Reviews*, 7(2), April 2020. <https://www.ijrar.org>

92. Vamsee Krishna Ravi, Abhishek Tangudu, Ravi Kumar, Dr. Priya Pandey, Aravind Ayyagari, and Prof. (Dr) Punit Goel. (2021). Real-time Analytics in Cloud-based Data Solutions. *Iconic Research And Engineering Journals*, Volume 5 Issue 5, 288-305.

93. Das, Abhishek, Abhijeet Bajaj, Priyank Mohan, Punit Goel, Satendra Pal Singh, and Arpit Jain. (2023). “Scalable Solutions for Real-Time Machine Learning Inference in Multi-Tenant Platforms.” *International Journal of Computer Science and Engineering (IJCSE)*, 12(2):493–516.

94. Subramanian, Gokul, Ashvini Byri, Om Goel, Sivaprasad Nadukuru, Prof. (Dr.) Arpit Jain, and Niharika Singh. 2023. Leveraging Azure for Data Governance: Building Scalable Frameworks for Data Integrity. *International Journal of Research in Modern Engineering and Emerging Technology (IJRMEET)* 11(4):158. Retrieved (<http://www.ijrmeet.org>) .

95. Ayyagari, Yuktha, Akshun Chhapola, Sangeet Vashishtha, and Raghav Agarwal. (2023). Cross-Culturization of Classical Carnatic Vocal Music and Western High School Choir. *International Journal of Research in All Subjects in Multi Languages (IJRSML)*, 11(5), 80. RET Academy for International Journals of Multidisciplinary Research (RAIJMR). Retrieved from www.rajmr.com.

96. Ayyagari, Yuktha, Akshun Chhapola, Sangeet Vashishtha, and Raghav Agarwal. (2023). “Cross-Culturization of Classical Carnatic Vocal Music and Western High School Choir.” *International Journal of Research in all Subjects in Multi Languages (IJRSML)*, 11(5), 80. Retrieved from <http://www.rajmr.com>.

97. Shaheen, Nusrat, Sunny Jaiswal, Pronoy Chopra, Om Goel, Prof. (Dr.) Punit Goel, and Prof. (Dr.) Arpit Jain. 2023. Automating Critical HR Processes to Drive Business Efficiency in U.S. Corporations Using Oracle HCM Cloud. *International Journal of Research in Modern Engineering and Emerging Technology (IJRMEET)* 11(4):230. Retrieved (<https://www.ijrmeet.org>) .

98. Jaiswal, Sunny, Nusrat Shaheen, Pranav Murthy, Om Goel, Arpit Jain, and Lalit Kumar. 2023. Securing U.S. Employment Data: Advanced Role Configuration and Security in Oracle Fusion HCM. *International Journal of Research in Modern Engineering and Emerging Technology (IJRMEET)* 11(4):264. Retrieved from <http://www.ijrmeet.org>.

99. Nadarajah, Nalini, Vanitha Sivasankaran Balasubramaniam, Umababu Chinta, Niharika Singh, Om Goel, and Akshun Chhapola. 2023. Utilizing Data Analytics for KPI Monitoring and Continuous Improvement in Global Operations. *International Journal of Research in Modern Engineering and Emerging Technology (IJRMEET)* 11(4):245. Retrieved (www.ijrmeet.org) .

100. Mali, Akash Balaji, Arth Dave, Vanitha Sivasankaran Balasubramaniam, MSR Prasad, Sandeep Kumar, and Sangeet. 2023. Migrating to React Server Components

(RSC) and Server Side Rendering (SSR): Achieving 90% Response Time Improvement. *International Journal of Research in Modern Engineering and Emerging Technology (IJRMEET)* 11(4):88.

101. Shaik, Afroz, Arth Dave, Vanitha Sivasankaran Balasubramaniam, Prof. (Dr) MSR Prasad, Prof. (Dr) Sandeep Kumar, and Prof. (Dr) Sangeet. 2023. Building Data Warehousing Solutions in Azure Synapse for Enhanced Business Insights. *International Journal of Research in Modern Engineering and Emerging Technology (IJRMEET)* 11(4):102.
102. Putta, Nagarjuna, Ashish Kumar, Archit Joshi, Om Goel, Lalit Kumar, and Arpit Jain. 2023. Cross-Functional Leadership in Global Software Development Projects: Case Study of Nielsen. *International Journal of Research in Modern Engineering and Emerging Technology (IJRMEET)* 11(4):123.
103. Subeh, P., Khan, S., & Shrivastav, A. (2023). User experience on deep vs. shallow website architectures: A survey-based approach for e-commerce platforms. *International Journal of Business and General Management (IJBGM)*, 12(1), 47–84. https://www.iaset.us/archives?jname=32_2&year=2023&submit=Search © IASET. Shachi Ghanshyam Sayata, Priyank Mohan, Rahul Arulkumaran, Om Goel, Dr. Lalit Kumar, Prof. (Dr.) Arpit Jain. 2023. The Use of PowerBI and MATLAB for Financial Product Prototyping and Testing. *Iconic Research And Engineering Journals*, Volume 7, Issue 3, 2023, Page 635-664.
104. Dharmapuram, Suraj, Vanitha Sivasankaran Balasubramaniam, Phanindra Kumar, Niharika Singh, Punit Goel, and Om Goel. 2023. "Building Next-Generation Converged Indexers: Cross-Team Data Sharing for Cost Reduction." *International Journal of Research in Modern Engineering and Emerging Technology* 11(4): 32. Retrieved December 13, 2024 (<https://www.ijrmeet.org>).
105. Subramani, Prakash, Rakesh Jena, Satish Vadlamani, Lalit Kumar, Punit Goel, and S. P. Singh. 2023. Developing Integration Strategies for SAP CPQ and BRIM in Complex Enterprise Landscapes. *International Journal of Research in Modern Engineering and Emerging Technology* 11(4):54. Retrieved (www.ijrmeet.org).
106. Banoth, Dinesh Nayak, Priyank Mohan, Rahul Arulkumaran, Om Goel, Lalit Kumar, and Arpit Jain. 2023. Implementing Row-Level Security in Power BI: A Case Study Using AD Groups and Azure Roles. *International Journal of Research in Modern Engineering and Emerging Technology* 11(4):71. Retrieved (<https://www.ijrmeet.org>).
- 107.
108. Rafa Abdul, Aravind Ayyagari, Krishna Kishor Tirupati, Prof. (Dr) Sandeep Kumar, Prof. (Dr) MSR Prasad, Prof. (Dr) Sangeet Vashishtha. 2023. Automating Change Management Processes for Improved Efficiency in PLM Systems. *Iconic Research And Engineering Journals* Volume 7, Issue 3, Pages 517-545.
109. Siddagoni, Mahaveer Bikshapathi, Sandhyarani Ganipaneni, Sivaprasad Nadukuru, Om Goel, Niharika Singh, Prof. (Dr.) Arpit Jain. 2023. Leveraging Agile and TDD Methodologies in Embedded Software Development. *Iconic Research And Engineering Journals* Volume 7, Issue 3, Pages 457-477.
110. Hrishikesh Rajesh Mane, Vanitha Sivasankaran Balasubramaniam, Ravi Kiran Pagidi, Dr. S P Singh, Prof. (Dr.) Sandeep Kumar, Shalu Jain. "Optimizing User and Developer Experiences with Nx Monorepo Structures." *Iconic Research And Engineering Journals* Volume 7 Issue 3:572-595.
111. Sanyasi Sarat Satya Sukumar Bisetty, Rakesh Jena, Rajas Paresh Kshirsagar, Om Goel, Prof. (Dr.) Arpit Jain, Prof. (Dr.) Punit Goel. "Developing Business Rule Engines for Customized ERP Workflows." *Iconic Research And Engineering Journals* Volume 7 Issue 3:596-619.
112. Arnab Kar, Vanitha Sivasankaran Balasubramaniam, Phanindra Kumar, Niharika Singh, Prof. (Dr.) Punit Goel, Om Goel. "Machine Learning Models for Cybersecurity Techniques for Monitoring and Mitigating Threats." *Iconic Research And Engineering Journals* Volume 7 Issue 3:620-634.
113. Kyadasu, Rajkumar, Sandhyarani Ganipaneni, Sivaprasad Nadukuru, Om Goel, Niharika Singh, Prof. (Dr.) Arpit Jain. 2023. Leveraging Kubernetes for Scalable Data Processing and Automation in Cloud DevOps. *Iconic Research And Engineering Journals* Volume 7, Issue 3, Pages 546-571.
114. Antony Satya Vivek Vardhan Akisetty, Ashish Kumar, Murali Mohana Krishna Dandu, Prof. (Dr) Punit Goel, Prof. (Dr) Arpit Jain; Er. Aman Shrivastav. 2023. "Automating ETL Workflows with CI/CD Pipelines for Machine Learning Applications." *Iconic Research And Engineering Journals* Volume 7, Issue 3, Page 478-497.
115. Gaikwad, Akshay, Fnu Antara, Krishna Gangu, Raghav Agarwal, Shalu Jain, and Prof. Dr. Sangeet Vashishtha. "Innovative Approaches to Failure Root Cause Analysis Using AI-Based Techniques." *International Journal of Progressive Research in Engineering Management and Science (IJPREMS)* 3(12):561–592. doi: 10.58257/IJPREMS32377.
116. Gaikwad, Akshay, Srikanthudu Avancha, Vijay Bhasker Reddy Bhimanapati, Om Goel, Niharika Singh, and Raghav Agarwal. "Predictive Maintenance Strategies for Prolonging Lifespan of Electromechanical Components." *International Journal of Computer Science and Engineering (IJCSE)* 12(2):323–372. ISSN (P): 2278–9960; ISSN (E): 2278–9979. © IASET.
117. Gaikwad, Akshay, Rohan Viswanatha Prasad, Arth Dave, Rahul Arulkumaran, Om Goel, Dr. Lalit Kumar, and Prof. Dr. Arpit Jain. "Integrating Secure Authentication Across Distributed Systems." *Iconic Research And Engineering Journals* Volume 7 Issue 3 2023 Page 498-516.
118. Dharuman, Narrain Prithvi, Aravind Sundeep Musunuri, Viharika Bhimanapati, S. P. Singh, Om Goel, and Shalu Jain. "The Role of Virtual Platforms in Early Firmware Development." *International Journal of Computer Science and Engineering (IJCSE)* 12(2):295–322. <https://doi.org/ISSN2278-9960>.